STANDARDIZED METHOD AND APPARATUS FOR GATHERING DEVICE IDENTIFICATION AND/OR CONFIGURATION INFORMATION VIA A PHYSICAL INTERFACE

BACKGROUND OF THE INVENTION

The present invention involves gathering device identification (ID) and configuration information from a device within the world-wide web (Internet). More particularly, it concerns a standardized physical interface and protocol for gathering, recording and using such information.

The identity (e.g. hostname, Internet protocol (IP) address, Medium Access Control (MAC) address, Common Language Location Identifier (CLLI) code, etc.) and configuration of any given device can change at any given point in time. Generally this information is available through some sort of network connection or console interface. The problem is that different types of devices require different commands in order to retrieve this information.

SUMMARY OF THE INVENTION

Accordingly, a standard physical interface with a standardized response protocol would enable a craft or technician employee accurately and quickly to verify network devices' various identities and configurations, including relatively fixed hardware configurations and relatively rapidly changing software configurations. The apparatus for gathering network device data includes a first non-volatile memory on the network device storing defined device-specific data and being writable via the network and also readable. The apparatus further includes a physical read port on the network device including a set of one or more signals defining a physical interface and a protocol for reading the data from the first memory. Finally, the apparatus includes data-gathering means physically separate from but compatible with the read port and programmed to read the data from the first memory in accordance with the protocol, the data-gathering means including a second non-volatile memory for recording the data read from the first memory. The first memory may be partitioned to include plural storage locations for data of various types including network device identification data regarding hostname, IP address, MAC address, CLLI codes and physical device location, as well as configuration data regarding at least hardware and software revisions.

The method includes providing a network device with a non-volatile memory and with an externally accessible physical data read port; programming one or more memory locations therein with data regarding the identification and configuration thereof, the one or more memory locations being readable by an external reader mechanism over the port; and

5   providing a portable reader mechanism external to the network device but physically and logically compatible therewith for reading and recording the data from the network device. The gathered, portable data thus recorded can be used for reporting, maintenance, quality assurance, inventory and other purposes. By making the interface an industry standard, network-wide data may be gathered, independent of the particular design or manufacture of

10   the diverse hardware and software in which the invented method and apparatus are embedded.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic system block diagram of the invented apparatus in accordance

15   with a preferred embodiment of the invention.

Fig. 2 is an isometric view of the apparatus in accordance with a preferred embodiment of the invention showing the Internet device mounted within a network hardware rack for physical porting with an external portable reader mechanism.

Fig. 3 is a schematic diagram illustrating the data stored within one or more memories

·20   in accordance with the invention.

Fig. 4 is a flowchart illustrating the method in accordance with a preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

25   Apparatus 10 is shown schematically and physically in Figs. 1 and 2. Apparatus 10 may be understood to take the form of a modification to an existing Internet device such as those indicated at 12 within the NETWORK cloud. Internet device 12 is installed in an Internet hardware rack 14 along with other similar or dissimilar Internet devices. Hardware rack 14 may be configured as an Internet-connected gateway, server, local area network

30   (LAN) node, or the like. Internet device 12 may be any hardware component of such an Internet-connected device, and may be represented physically as one or more separate so-called cards. Typically, device 12 has a non-volatile first memory 16 and a microprocessor or other digital controller 18.

Apparatus 10 includes first memory 16, which stores defined device-specific data. Such device-specific data (specific to device 12) are written via the network upon network supervisor command. First memory 16 in accordance with the invention is partitioned to include plural storage locations for data of various types, including identification and

5   configuration data, as will be seen. First memory 16 initially may be written at the time of manufacture and further may be written via supervisory command over the network. Such data are readable via a distinctive physical read port 20 on network device 12.

Physical port 20 includes a set of one or more signals defining a suitable physical interface and a suitable protocol for reading the data from first memory 16. Physically

10   separate from, but physically and logically compatible with, physical port 20 is data-gathering means, or a portable reader mechanism, 22 for reading and recording the data from first memory 16 of Internet device 12. Data gathering means 22 may take the form of a handheld portable device including a second memory 24 and a second microprocessor or digital controller 26. Data gathering means 22 is configured, e.g. digital controller 26.is

15   programmed, to read the data from first memory 16 in accordance with the protocol and to record the same into the second memory 24.

Those of skill in the art will appreciate that physical port 20 is made to be easily accessible to a user of portable reader mechanism 22, thereby enabling the user to gather, record, transport and use network device data specific to a given network device such as

20   device 12. Such data as may be written into first memory 16 thus may be read therefrom by portable reader mechanism 22 and stored in portable form for further use, e.g. for inventorying an Internet installation. Such network device identification data as may be stored in first memory 16 include one or more of hostname, IP address, MAC address, one or more CLLI codes and physical device location information, e.g. rack slot number, or the like.

25   Such network device configuration data as may be stored in first memory 16 include hardware and/or software configuration data, e.g. revision indicia such as an alphanumeric revision level for the various hardware and/or software components.

It may be seen from Fig. 2 that, in accordance with a preferred embodiment of the invention, plural instances 20a, 20b of physical port 20 may be provided in at least two

30   distinct physical locations thereon. Such plural instances of port 20 will be understood by those of skill in the art to provide parallel (but not necessarily concurrent) access to first memory 16 for reading the (same) device-specific data therefrom. This is because alternative manufactures or installations of Internet device rack 14 may have different rack mounting

configurations whereby a card, for example, may be mounted with its rearward edge or with its forward edge accessible to a user of apparatus 10, but not both. Thus, redundant instances of port 20 assure easy access independent of manufacture or installation. Those of skill in the art will appreciate that a particular network device such as a server may be embodied in one

5 or more integral hardware devices or cards such as that shown in Fig. 2. Many such multi-card network devices already are equipped to communicate status internally, i.e. within a rack of equipment. Thus the invention is broadly applicable to gathering data from a single board (each of which may be equipped with the invented apparatus) or to a set of logically interconnected plural boards (one or more of which may be so equipped).

10 The MAC protocol provides the data link layer of the Ethernet local area network (LAN) system. The MAC protocol encapsulates an SDU (payload data) by adding a fourteen-byte header (protocol control information (PCI)) before the data and by appending a four- byte (thirty-two bit) cyclic redundancy check (CRC) after the data. The entire frame is preceded by a short idle period (the minimum inter-frame gap, e.g. 9.6 microseconds (9.6µs),

15 and an eight-byte preamble. Most of the network devices have a unique MAC address on their physical interfaces.

The Extensible Markup Language (XML) is the universal format for structured documents and data on the Internet (the world-wide network or web). The use of a standard format for data storage, retrieval and use, in accordance with a preferred embodiment of the

20 invention, makes the interfacing of such data with other programs and users far more convenient. Thus, it is preferred that the identification and configuration data be stored in XML format in at least the first memory within the network device, and preferably also in the second memory within the portable reader mechanism. Those of skill in the art will appreciate, however, that data may be formatted for storage in memory in any suitable form,

25 within the spirit and scope of the invention.

Physical contact with the interface would automatically signal the device to transmit identity, software configuration and hardware configuration through the physical interface. Identity would be in any suitable form and would include the current hostname and/or primary IP Address along with any associated MAC addresses, CLLI code(s) and rack

30 position/location. Software configuration would include any or all information from the full running configuration on the device to as little as key information that is specifically tagged to be transmitted when the software configuration field is polled by the external device. Hardware configuration would include any or all vendor part numbers included in the device,

along with revision or patch numbers for all field-replaceable cards and the main chassis. The physical interface would ideally be placed at multiple locations on the device (at least front and back), to facilitate easy access without regard to a particular racking convention.

Physical and logical inventory down to each individual part and chassis thus may be obtained by simply interfacing with the device via an external port. Moreover, obtaining useful information does not rely on a network connection, which may be relatively impossible due to high traffic or network gateway line, server or device problems.

Were such an interface as described herein adopted globally in the industry, all inventory could be gathered in the same fashion using the same interface.

Minimal physical access is required to determine exactly what cards or revision of cards were in a particular device. For example, as little data as device type and/or model number and/or revision letter for hardware and/software may be polled from the device. Or as much data as that and hardware and software configuration details may be determined by polling the non-volatile memory locations that contain such information. It is more beneficial, of course, to have more information than less, but even a minimalist approach to device information gathering is contemplated as a low-cost and low-impact implementation of the invention, and is within the spirit and scope thereof.

Those of skill in the art will appreciate that inventory can be performed semi-automatically without the presence of network connectivity or console interfaces. This represents a great advantage over approaches to device identification and configuration gathering method and apparatus that would require all of the various and remote hardware and software components in the network system to be fully operational and communicative.

Preferably, configuration information is maintained in a standard format, e.g. in accordance with the existing XML format. Such a standard data format allows seamless usage with existing tools for data manipulation and storage. Also preferably, flash memory (or a portion of existing flash memory or non-volatile read-and-write or random access memory (NVRAM) stores the data to be acquired. Thus, the data is maintained in a non-volatile memory that is not erased upon power down of either the network device or the external reader mechanism. Such flash/NVRAM memory in accordance with a preferred embodiment of the invention is powered by the device itself. But it will be appreciated that, alternatively and yet within the spirit and scope of the invention, DC power could be supplied over the physical interface by the external reader mechanism itself.

Also preferably, a standard hardware signal configuration, e.g. an RS-232 interface, defines the physical and handshake protocol by which network device data are read by the external reader mechanism. Such an interface is asynchronous and bit serial, thereby reducing input/output signal requirements, simplifying design, layout and access and

5   lowering recurrent cost, e.g. material, labor and overhead (MLO).

Within the spirit and scope of the invention, however, any suitable alternative hardware interface and handshake protocol may be used. The physical connector may be modified to be of the quick-connect and quick-disconnect type, thereby facilitating data porting from the network device to the external reader mechanism. Alternatively, within the

10   spirit and scope of the invention, the physical connector may be of custom or proprietary design. In accordance with the RS-232 interface standard, the Request-To Send (RTS)/Clear-To-Send (CTS) handshake may be used for flow control. Similarly, Data Terminal Ready (DTR) may be used to determine whether the flash memory is available (i.e. that flash memory is not in the middle of an identification data-related or a configuration data-related

15   write process). In other words, DTR may be used to avoid memory contention and/or race conditions between maintenance (e.g. update) network operations initiated by a server and polling operations initiated by an external reader mechanism, which might otherwise inadvertently produce stale or even inaccurate identification and configuration data.

Preferably, plural instances of such a physical connector are provided, as shown in

20   Fig. 2, e.g. adjacent two opposing peripheral edges, e.g. a forward and a rearward edge, of the network device card or box. This renders the physical port easily accessed regardless of the device's configuration within a particular network hardware rack.

A preferred general data storage format is illustrated in Fig. 3, showing that one or more of device identification and configuration data easily and efficiently may be stored in

25   first and second memories 16, 24. One or more memory locations may be allocated to storage of identification data including one or more of the hostname, the IP address, MAC address, one or more CLLI codes and physical device location information for network device 12, as shown. Similarly, one or more memory locations may be allocated to storage of device configuration data including hardware and software configuration data, as shown.

30   Such hardware and software configuration data may include hardware and software revision indicia, as shown. Those of skill in the art will appreciate that the allocated memory locations may be consecutive or not, and the identification and configuration memory blocks may be consecutive of not, within the spirit and scope of the invention. Finally, it is recalled

that SML is the preferred storage format for all such data that is stored, whether in first memory 16 or second memory 24, although alternative form and content of memory are contemplated and are within the spirit and scope of the invention.

The method of the invention now may be understood, from the above description of 5 the invented apparatus. Turning briefly to Fig. 4, a first invented method step 100 includes providing a network device with a non-volatile memory and with an externally accessible physical data read port thereto. Such may be accomplished by simply allocating one or more memory locations to the invented network device identification and configuration data storage task.

10 A second invented method step 102 includes programming one or more memory locations in the network device with data regarding the defined identification and configuration of the network device. Such may be accomplished by any suitable network-based telecommunication, e.g. a supervisory or maintenance network server at a remote or central location may simply download such network device-specific data to any or all such 15 devices within a network. Additionally or alternatively, such network device-specific data may be programmed into the memory locations at the time of manufacture, for optional later updating via such telecommunications over the network.

A third invented method step 104 includes providing a portable reader mechanism external to the network device, but physically and logically compatible therewith, for reading 20 and recording the programmed data from the network device. Such may be accomplished in any suitable form of the apparatus, preferably in the form of a lightweight portable reader mechanism that may be used to poll such network device-specific data from any and all such network devices.

Those of skill in the art will appreciate that the more standard the physical interface 25 and command and read prompt protocols and data storage formats, the wider utility and facility provided under the principles of the invention. The adoption of a network-wide or industry standard physical and logical interface and porting protocol and data format is most preferable, as such permits inventory and revision control across the already vast and rapidly growing installed base of network devices and servers.

30 Finally, those of skill in the art will appreciate that the invented method and apparatus described and illustrated herein may be implemented in software, firmware or hardware, or any suitable combination thereof. Preferably, the method and apparatus are implemented in software, to the extent practical, for the purpose of low cost and flexibility. Thus, those of

skill in the art will appreciate that the method and apparatus of the invention may be implemented by a computer or microprocessor process in which instructions are executed, the instructions being stored for execution on a computer-readable medium and being executed by any suitable processor.

5   Alternative embodiments are contemplated, however, and are within the spirit and scope of the invention. For example, hardware portions of the method and apparatus including the memories within the network device and the external reader mechanism, and including the physical read port and any needed interface hardware such as a cable, are also contemplated. Within the spirit and scope of the invention, however such physical interface

10   may take any suitable form, e.g. data porting may be achieved via a wireless infrared transmission subsystem.

        Having illustrated and described the principles of our invention in a preferred embodiment thereof, it should be readily apparent to those skilled in the art that the invention can be modified in arrangement and detail without departing from such principles. We claim

15   all modifications coming within the spirit and scope of the accompanying claims.